Childhood Obesity and Proximity to Urban Parks and Recreational Resources: A Longitudinal Cohort Study

Presented by Jennifer Wolch

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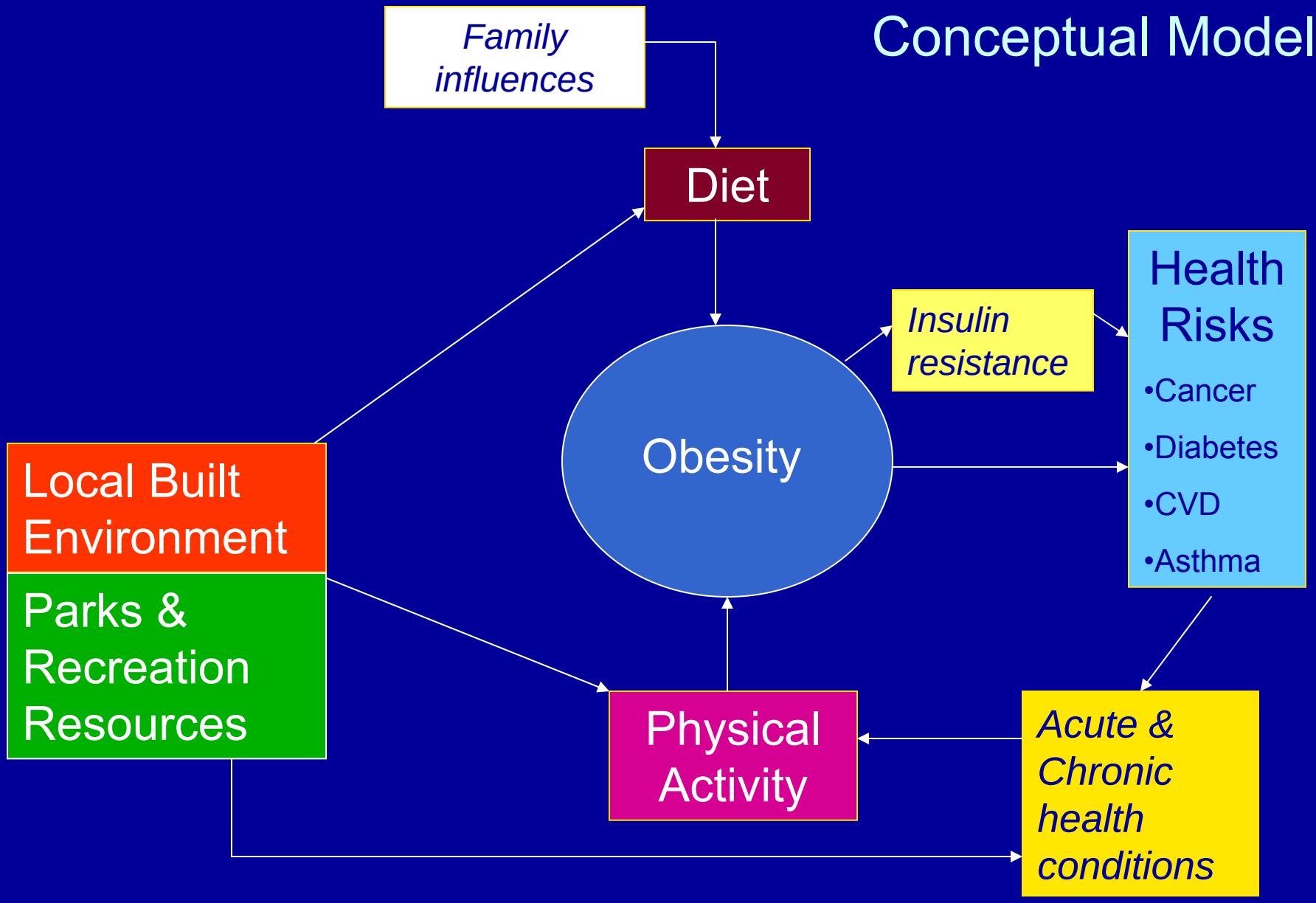
Background

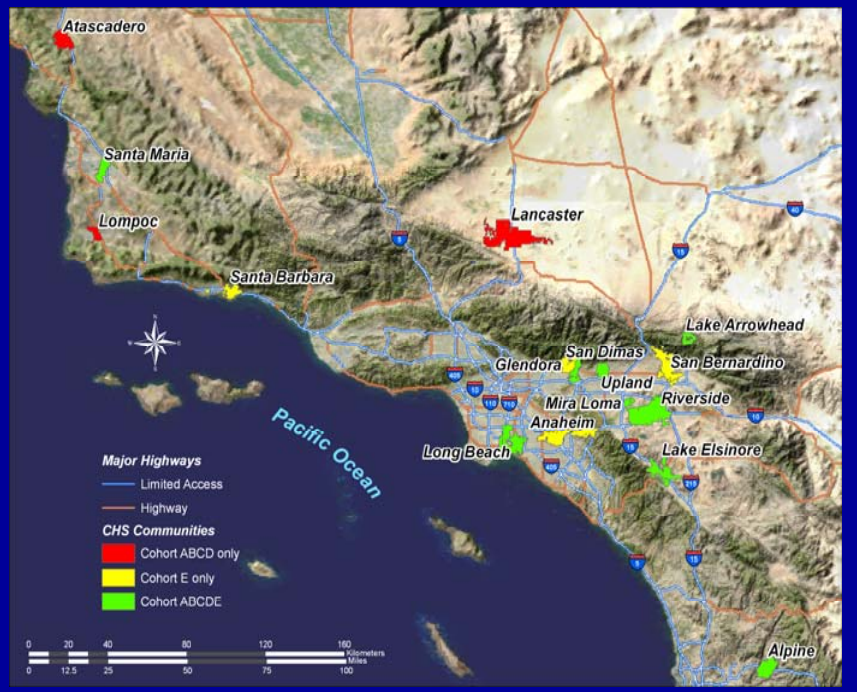
- Built environment is increasingly linked to physical activity and obesity
- But few longitudinal studies of built environment determinants of obesity have been conducted with children
- Children's Health Study (CHS) offers longitudinal sample with objectively measured BMI (Kg/m^2) data

Conceptual Model

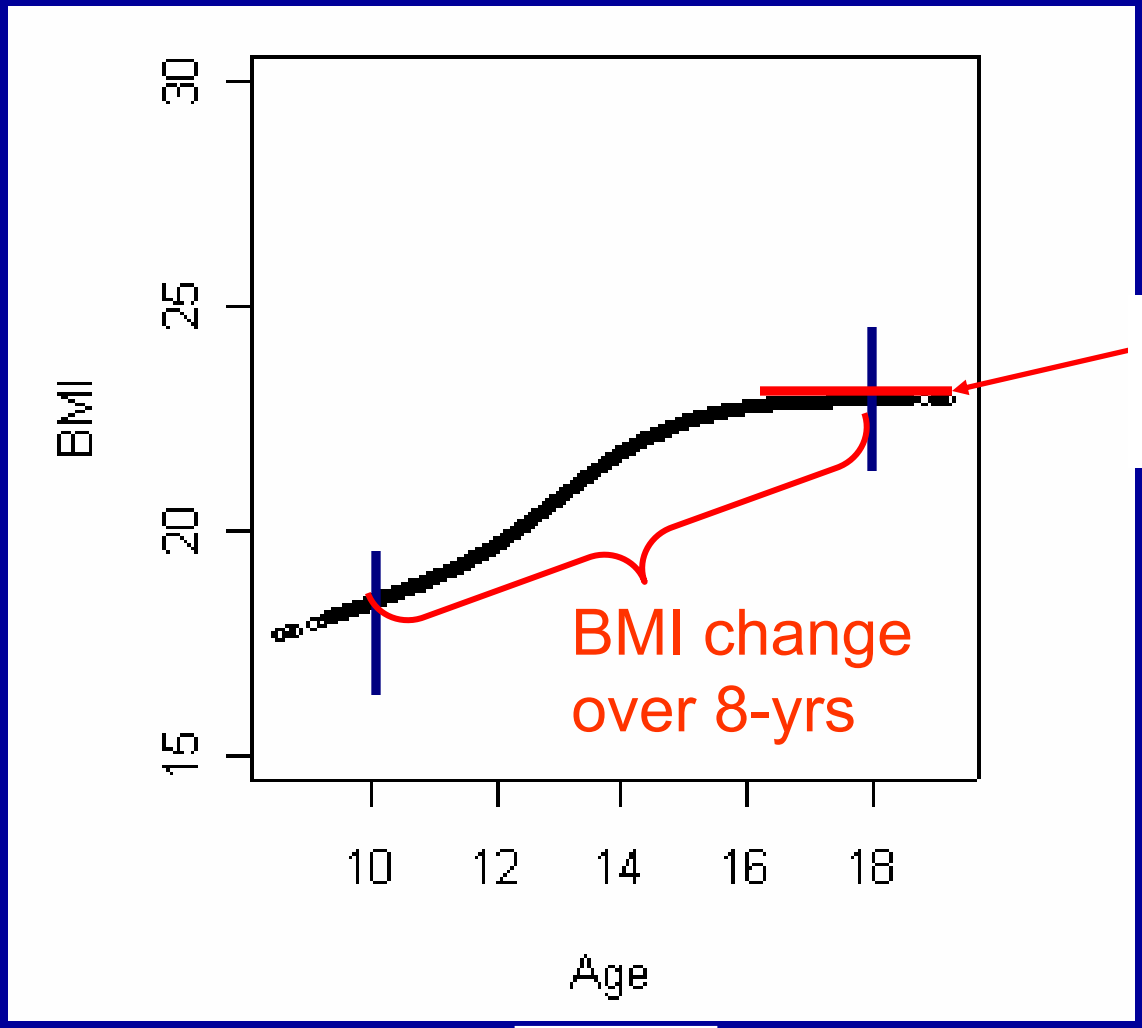


Data and Methods

- 11,797 CHS children
  - Up to 8 years of follow up
  - Building on $50+ million prior investment
  - 12 Southern California communities
  - BMI measured yearly by trained staff
- Geospatial data
  - Land use
  - Transportation
  - Business locations
  - Public facilities/programs
  - Green cover
  - Air pollution
- Use of flexible growth curve multilevel modeling

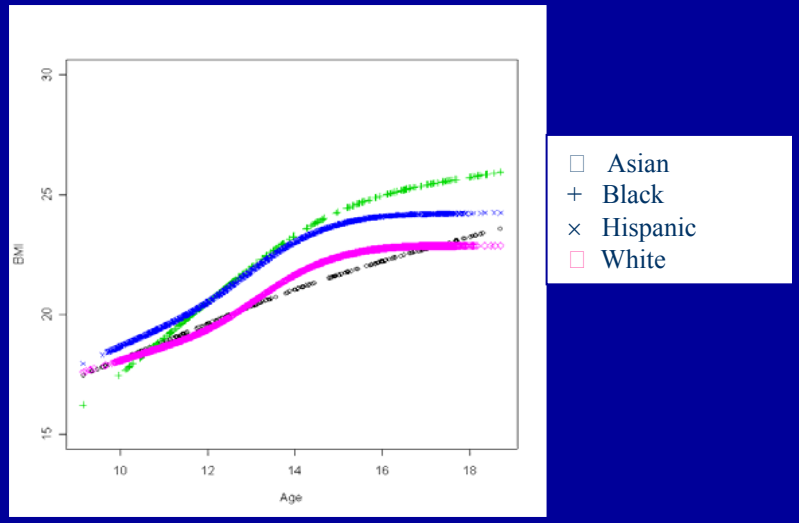


Models Focus on *Attained BMI at Age 18*



Multilevel Modeling of BMI Trajectories

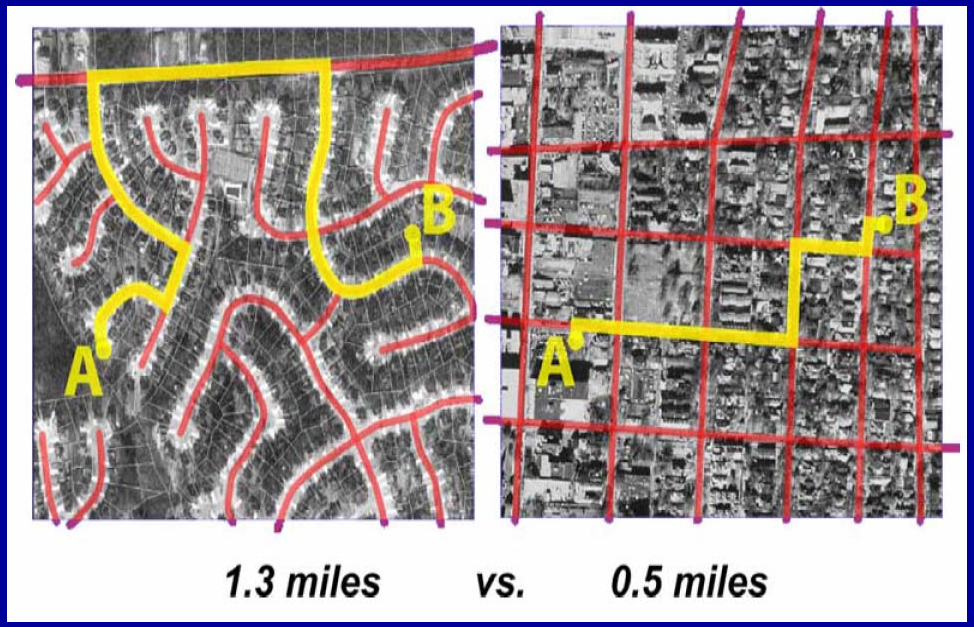
Level 1: Within subject/between times



Allows for:

- Prediction of attained BMI levels for each subject at any age
- Calculation of 8-yr BMI growth slope for each child
- Adjustment of time-dependent covariates (e.g., health status)
- Non-linear growth trajectory due to puberty

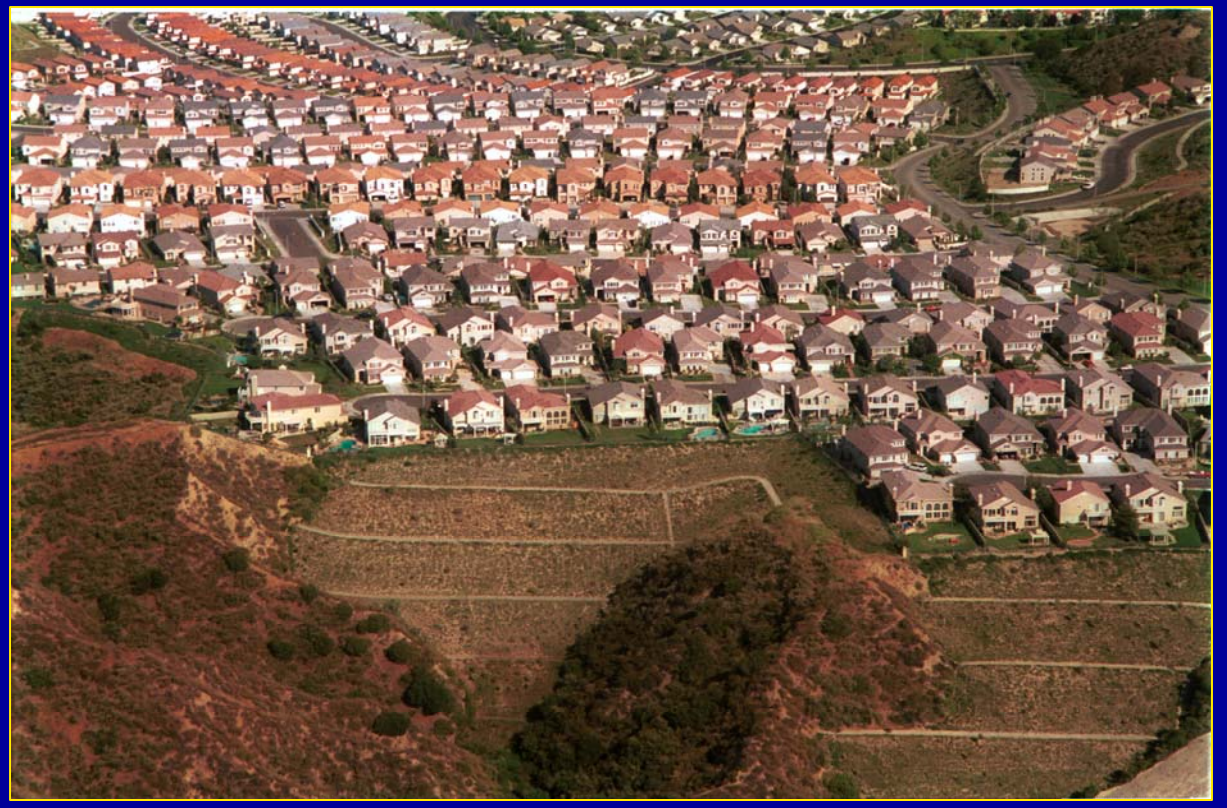
Level 2: Between subjects/within community



Allows for:

- Within-community built environment effects
- Community average of 8-yr BMI growth
- Adjustment of time-independent covariates (e.g., ethnicity)
- Control of individual-level errors

Level 3: Between communities



Allows for:

- Between-community pollution effect, urban sprawl, crime
- Adjustment of ecologic covariates

Characteristics of Analytic Cohort Age 10-18

Cohort (year, # of subjects)	**Prevalence Rate (%) of overweight (BMI ≥ 85th %ile)**				
	All	Ethnicity			
		Non-Hispanic White	Hispanic	African American	Asian
(1993: 2192)	25.3	21.6	36.0	20.2	15.9
(1996: 2081)	27.5	24.0	34.5	31.0	21.6

Analytic Cohort N = 3318 with 8 years of follow up from ages 10-18

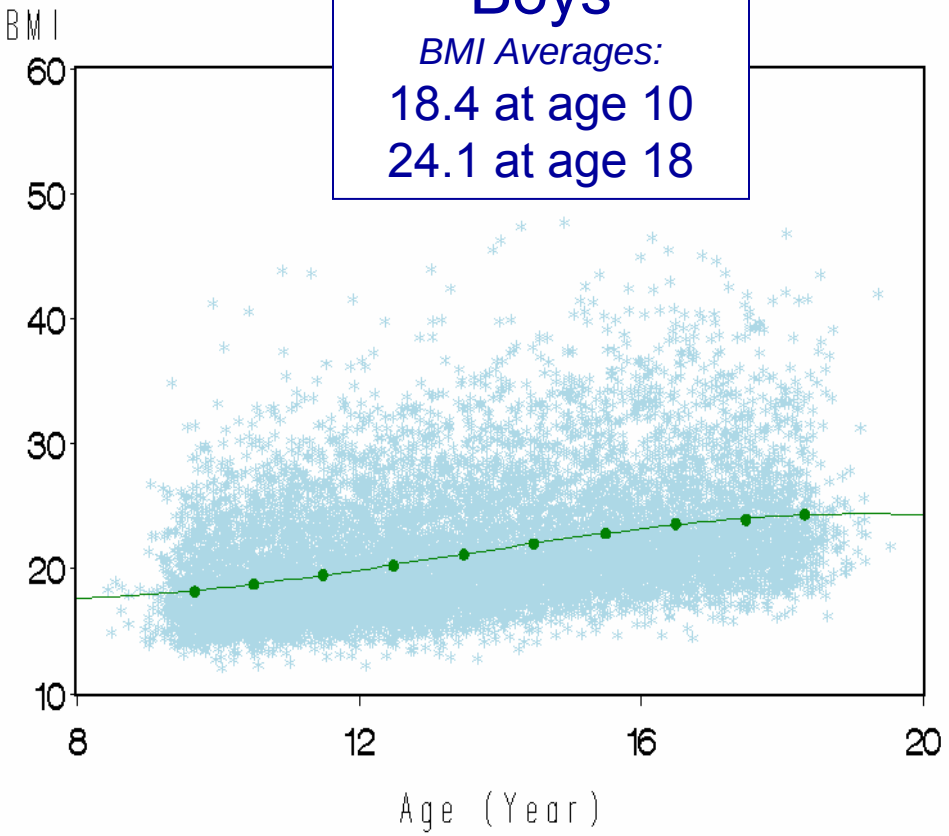
BMI Growth Over 8 Years

Boys

BMI Averages:

18.4 at age 10

24.1 at age 18

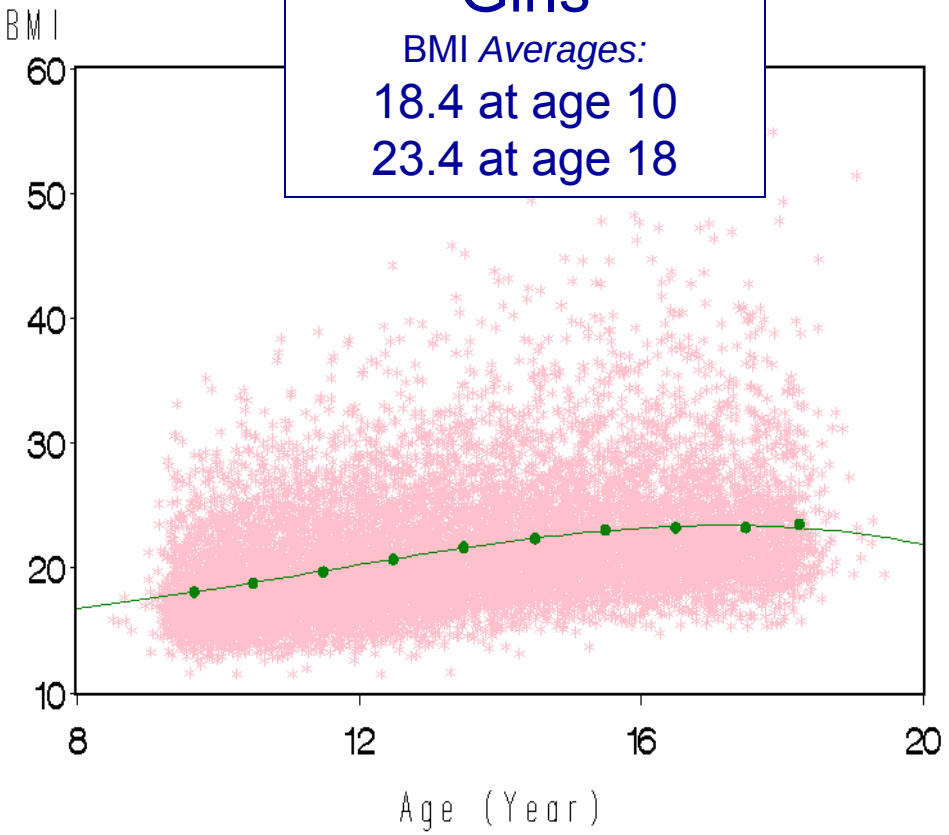


Girls

BMI *Averages:*

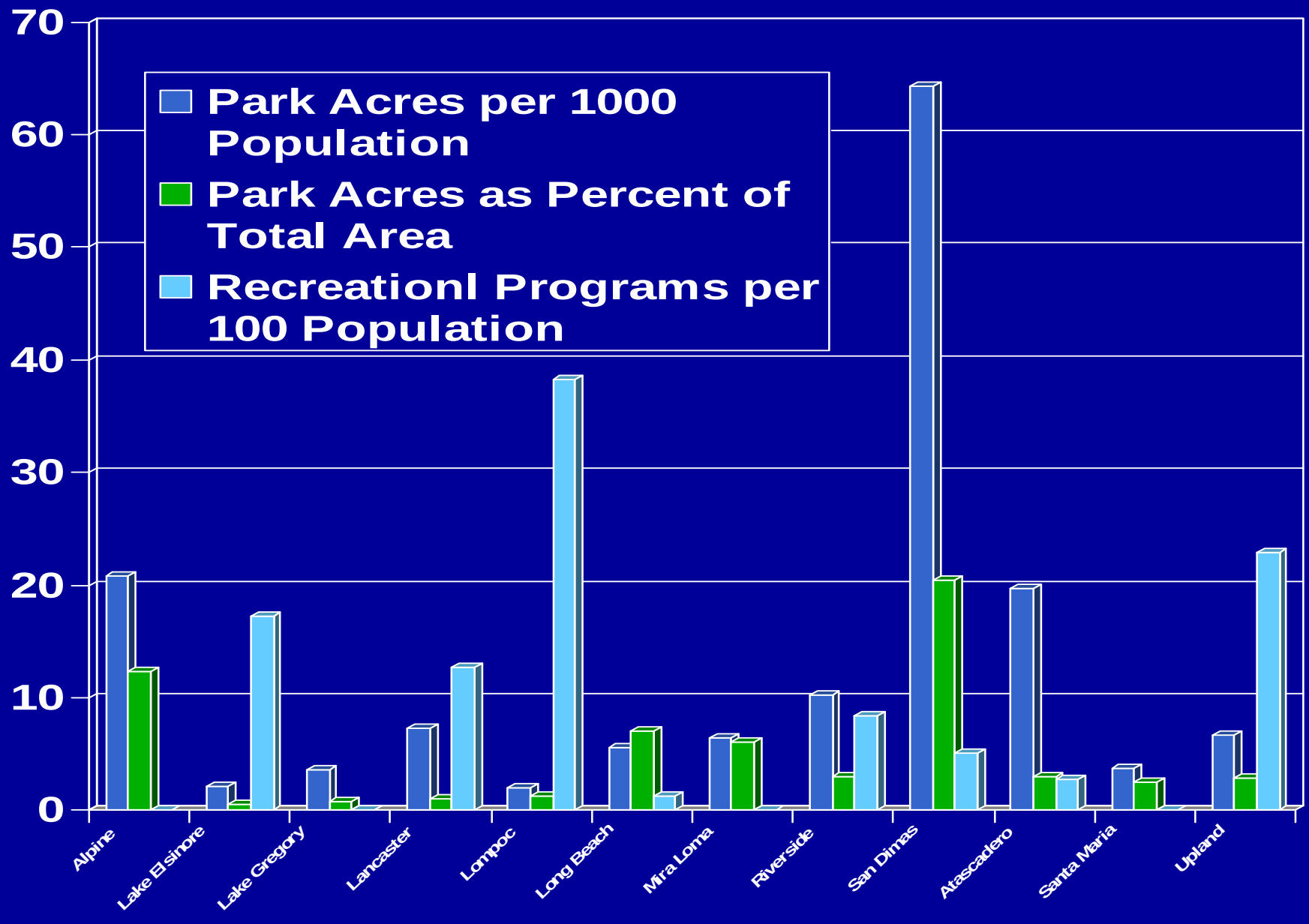
18.4 at age 10

23.4 at age 18



General Characteristics of Study Communities

- Range of community size
  - Long Beach (2000 pop. 406,151)
  - Lake Gregory (2000 pop. 15,431)
- Mix of community types
  - Older central cities (Long Beach, Riverside)
  - Inner ring suburbs (San Dimas)
  - Suburbs (Lancaster, Mira Loma, Upland)
  - Distant exurbs (Lake Elsinore, Alpine)
  - Rural/resort communities (Santa Maria, Atascadero, Lompoc, Lake Gregory)
- Mix of class and race/ethnicity
  - Upland – white, affluent
  - Long Beach – Latino, lower-income


70
60
50
40
30
20
10
0
Park Acres per 1000 Population
Park Acres as Percent of Total Area
Recreationl Programs per 100 Population
Alpine
Lake Elsinore
Lake Gregory
Lancaster
Lompoc
Long Beach
Mira Loma
Riverside
San Dimas
Atascadero
Santa Maria
Upland

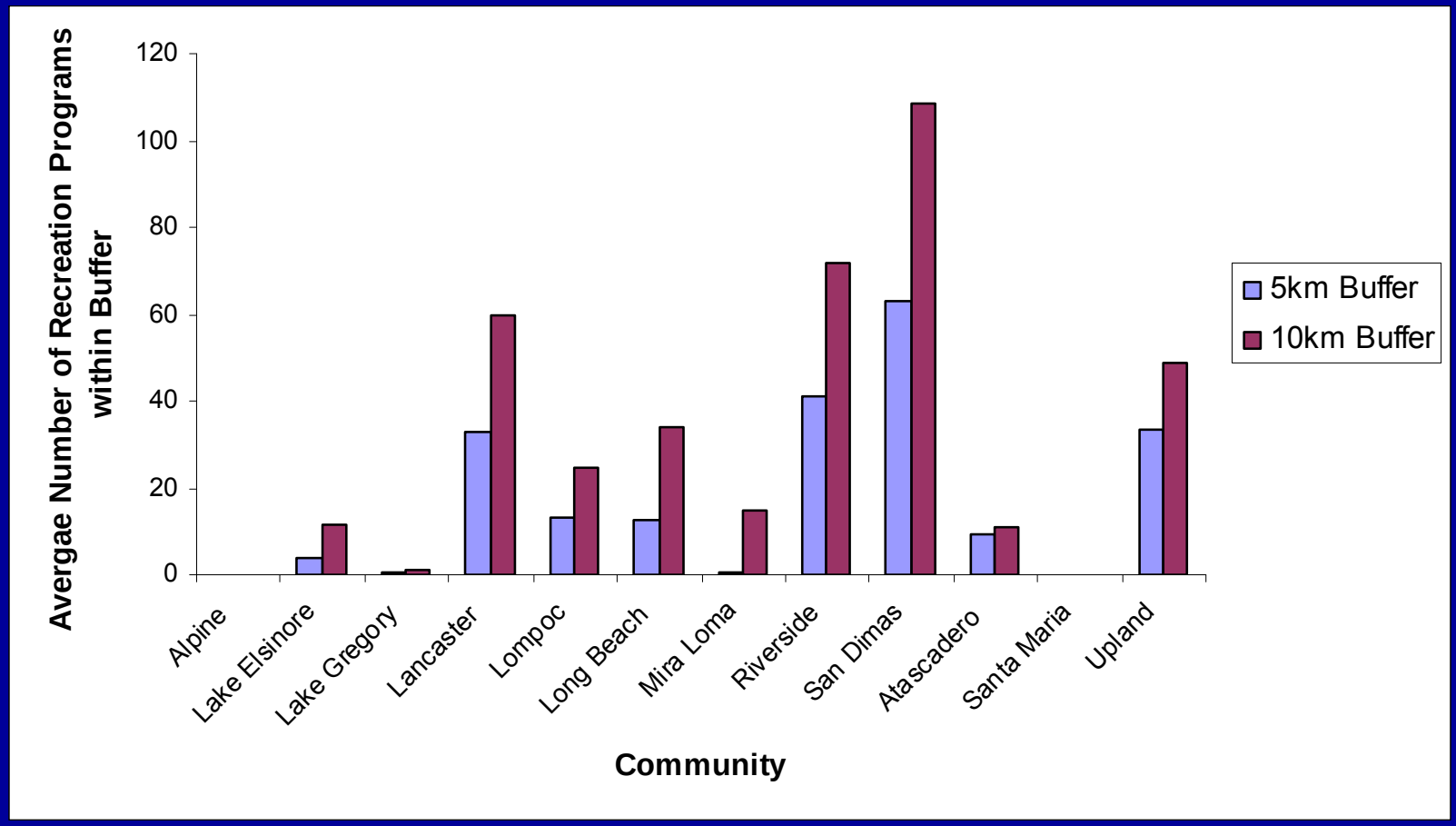
Park & Recreational Program Variables

- Park space within 200, 500, and 1000 m of child's home
- Public recreational programs within 5 km and 10 km of child's home

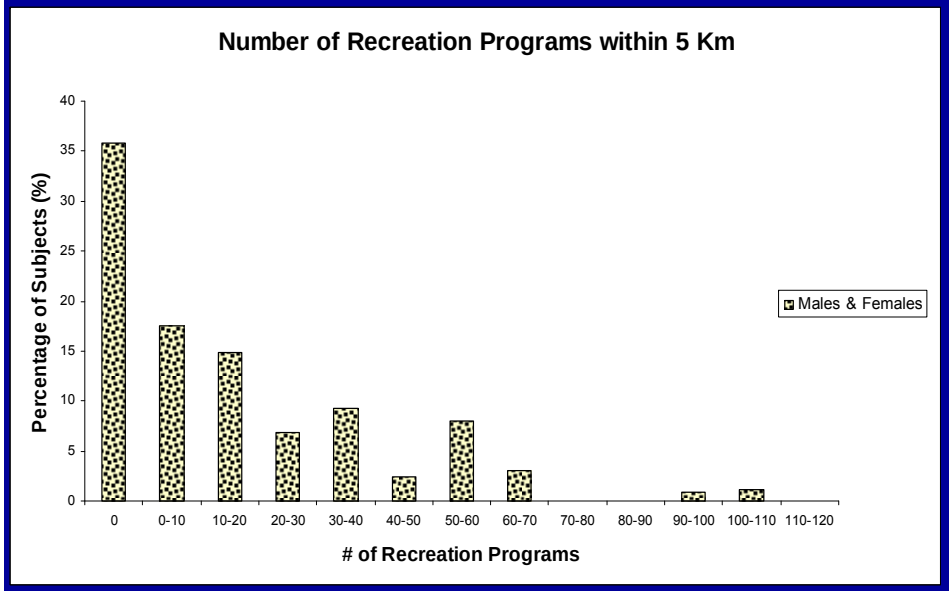
Recreational Audit

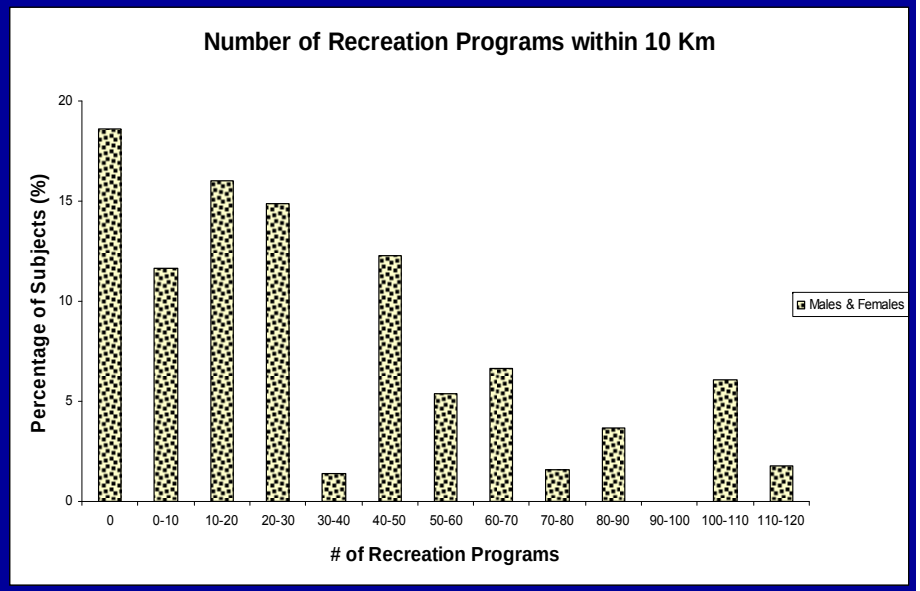
- All municipal websites in CHS study areas were systematically audited for information on recreation program offerings (Su 2006)
- Variables included program type, duration, cost, and target age group
- Location on/off park site also determined using GIS
- Web audit data augmented by direct contacts and ancillary private/nonprofit web sites

Distribution of Recreational Programs Across Study Communities



Access to Recreation Programs





Model Results

(8-year Growth Curves, Age Centered at 18, with adjustments for ethnicity, town, gender, cohort, and park/recreation specific confounders)

Variable of Interest	Effect: Males (std)	Effect: Females (std)
Park space (km) within 500 meter buffer	-0.012*** (0.005)	-0.007* (0.005)
Recreation programs within 5 km buffer	-0.015*** (0.004)	-0.008*** (0.004)
Recreation programs within 10 km buffer	-0.025*** (0.005)	-0.016*** (0.005)

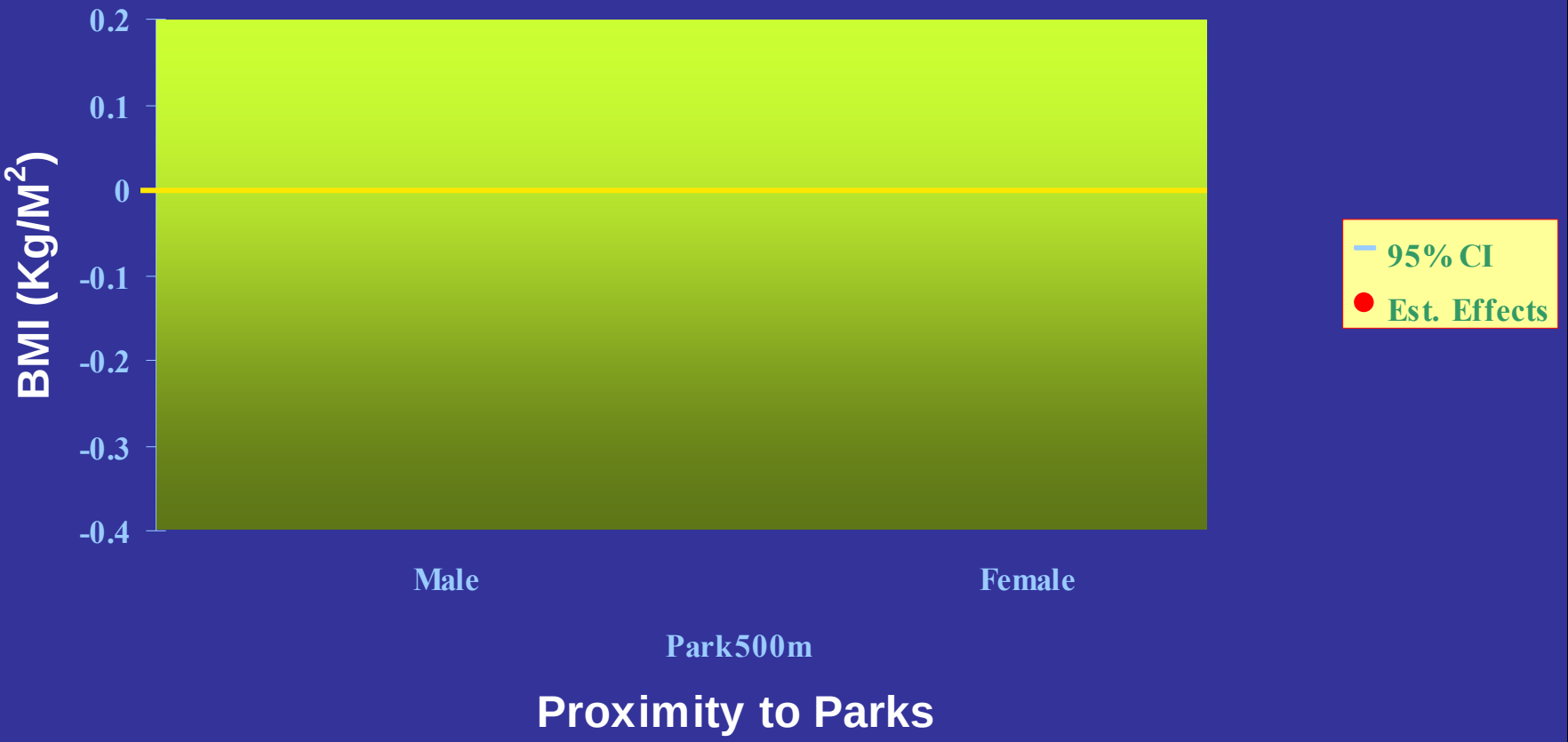
Model Confounders

	Major Outcomes		
	Parkland within 500 m	Total Number of Recreation Programs within 5 KM	Total Number of Recreation Programs within 10 KM
Traffic Density within 150 m Buffer	√	√	√
Traffic Density within 300 m Buffer	√	√	
Distance from Residence to Nearest Side of Highway		√	√
NDVI within 500 m Buffer	√	√	√
Buffer Population (Total Population within 500 m Buffer)		√	√
Average Urban Impreviousness within 500 m Buffer	√	√	√
Average Tree Canopy within 500 m Buffer		√	√
Total Length of Highway within 500 m Buffer		√	
Total Length of Major Arterial within 500 m Buffer	√	√	
Total Length of Airport Runway within 500 m Buffer			√
Agriculture Land Use within 500 m Buffer			√
Average Block Size of Blocks within 500 m Buffer		√	
Number of “X” Intersections within 500 m Buffer	√	√	√
Percent Below Poverty within Census Block	√	√	√
Percent Unemployment within Census Block		√	
Town Level Forcible Rape Rate			√

Results

- Park space within 500 m of child's home inversely associated with BMI at age 18
- Public recreational programs ≤10 km of child's home also protective for obesity
- Many children have poor access to public recreational programs
  - *Almost 20% have no access within 10 km*
  - *36% have no access within 5 km*

Proximity of Parks & BMI Level at Age 18 (10%-90%ile Scale)



Proximity of Recreation & BMI Level at Age 18 (10%-90%ile Scale)

Influence of Confounders

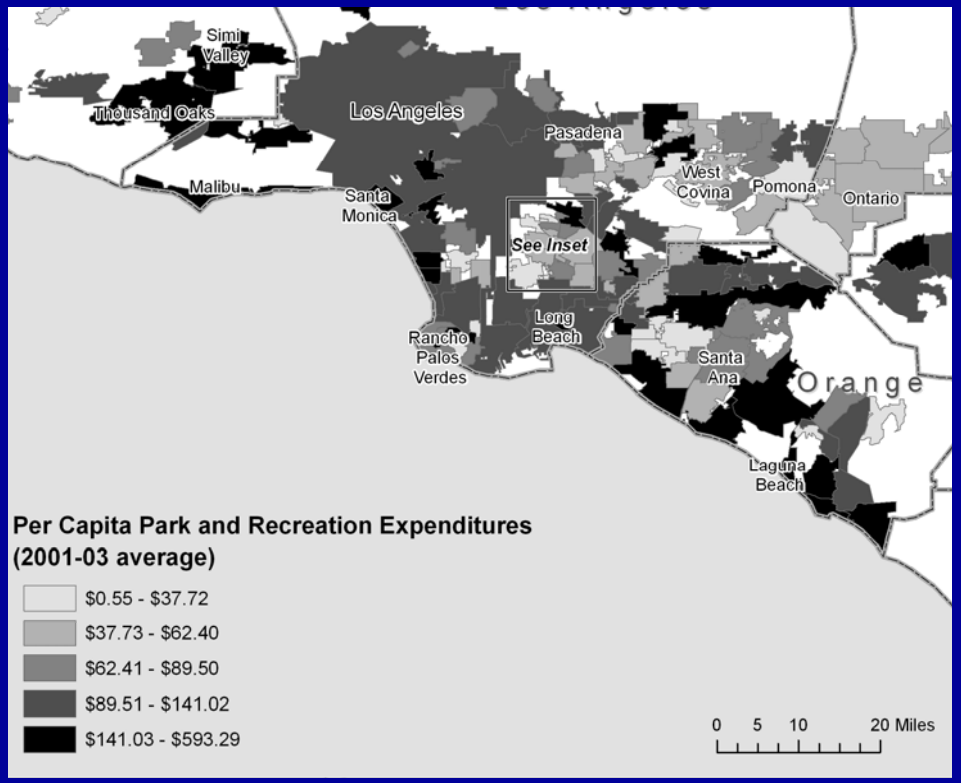
- Confounders for parks – lowered effect sizes but relationship between parks and BMI remained significant/negative
- Confounders for recreation – increased effect sizes, but differentially by gender (greater for boys)

Interpretation of Findings for Recreational Programs and BMI

- If all children had comparable access to recreational programs:
  - ***Boys:*** *11.26% move from overweight to normal; 3% from obese to overweight*
  - ***Girls:*** *8.5% move from overweight to normal; almost 3% from obese to overweight*

Connections to Active Living Interventions

- Increase park space and recreational programming near poor and minority neighborhoods with high densities of children



Next steps

- Focus on specific roles of gender, race/ethnicity, and age
- Refine selected model measures, for example, park quality/facilities, quality/diversity/cost/energy expenditure associated with recreation offerings
- Analyze children who stay lean in park/recreation-poor places and those who are obese in park/recreation-rich environments, to understand why
- Create a “obesity vulnerability” index to highlight geography of risk for planners, schools, public health officials